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SCIENCE AND TECHNICAL PROGRESS

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FOREWORD

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Following is a translation of an article by I. M. Fedorchenko in Vestnik Akademii Nauk SSSR (USSR Academy of Sciences Review), Vol. XXIX, No. 11, Moscow 1959, pages 58-64.

The decisions of the 21st Congress of the CPSU and of the June (1959) Plenum of the Central Committee of the CPSU forcefully defined the importance of progress in science and technology during the period of expanded construction of Communist society. The basis of a further rapid upsurge in our national economy is a continuous technical renewing of all its branches, automation of production processes, and the introduction of new equipment and technology, new working methods and new progressive materials.

The program of scientific and technical progress formulated by the Communist Party is inspiring Ukrainian scientists to make a penetrating study of the important theoretical problems and to struggle persistently to strengthen the connection between science and practice in Communist construction, and is presenting them with new responsible tasks.

The Ukrainian Academy of Sciences has a considerable number of well equipped scientific research institutes, laboratories and other scientific establishments in which a large force of highly skilled specialists work. During recent years the Academy's scholars have achieved definite successes in the fields of physics, mathematics, chemistry, geology, and biology, in the fields of technical and social sciences. And along with this, the Ukrainian scholars acknowledge clearly that the new tasks require new efforts in expanding and intensifying scientific activity, and in eliminating the serious shortcomings which still persist in the organization of scientific work.

As is known, the leading position among the natural sciences is now held by the physical sciences; progress in related sciences and in many branches of the national economy depends on the successful development of the physical sciences.

The Ukrainian scientists, participating actively in theoretical research in the field of nuclear physics, are working on the problems of the utilization of energy from the fission of the heavy nuclei of uranium, plutonium and other elements and of energy from the synthesis of light nuclei, and on the solution of problems of managing thermonuclear reaction, i.e., on the general problems of modern physics. Our scientists are working on the creation of new types of atomic reactors, new effective heat carriers for atomic power installations, and new heat transfer apparatus, and are continuing to study ways to intensify and automate atomic power installations.

The scientists of the Academy and of the other Ukrainian scientific establishments must intensify research in the field of semiconductors, work out related theoretical problems, and create and improve the technology for producing new semiconduction materials suitable for use at a wide range of temperatures.

The problems engrossing the Ukrainian specialists in the field of radio physics and electronics include the study of the physics and technology of millimeter and sub-millimeter radio waves, and research in the field of microwave spectroscopy. The solution of these problems has theoretical and practical importance for the development of radio vision and the improvement of radar methods. The study of processes occurring in the clouds with the aid of radio methods, and the discovery of methods for influencing the condition of cloudiness to artificially induce precipitation, is also quite current.

Among the very important mathematical problems in the 1959-1965 plan, Ukrainian scientists are devoting their main attention to problems in computer mathematics. The Computer Center of the Ukrainian Academy of Sciences established in 1958, must promote the establishment of such centers in large Ukrainian cities and the use of new electronic computers in industry and other branches of the national economy.

The results of theoretical research in the physical and mathematical sciences provide a foundation for the development of many applied technical disciplines. Scientists working in institutes of our Academy's Division of Technical Sciences have stated recently that they are capable of solving complex problems important for the national economy. The efforts of the researchers are being concentrated on the solution of such problems during the forthcoming Seven-Year Plan period.

One of the most important achievements of the Ukrainian scientists in the field of technical sciences is the establishment of a scientific basis for electric welding of metals. This progressive technological process enables a fundamental change in the methods of manufacturing machines and mechanisms. Very large casings, weighing hundreds of tons, can now be manufactured by welding several parts instead of making huge castings. Welding of seams 2 meters thick and 3 meters long has already begun.

The construction of a constant-flow, highly mechanized line to manufacture large-size rolled and welded shapes, being conducted with the assistance of the Institute of Electric Welding imeni Ye. O. Paton at the Dnepropetrovsk Plant imeni I. V. Babushkin, is giving a great economic effect.

The method of electric slag welding, worked out by the Institute's personnel, is now also being successfully put into use by our friends in the People's Republic of China, Czechoslovakia, and the German Democratic Republic. A number of very large firms in capitalist countries have requested us to sell them licenses for the equipment and for the technical process of electric slag welding.

N. S. Khrushchev's report to the 21st Congress of the CPSU points out the need for extensive measures to further introduce welding processes in industry. This requires that we increase our assistance to industry and

expand the front of scientific research in this field. Our scientists must ensure that methods for welding new steels and alloys are worked out, must further perfect machines, apparatuses and technology for welding, and must provide automation and mechanization of welding processes; they must solve the problem of using the electric slag process in metallurgy, etc.

Further technical progress is unthinkable without the creation of new materials which are highly durable but light, which are stable at high temperatures, and which are resistant to corrosion and wear, as well as materials with special magnetic and electrical properties.

The scientific personnel of a number of our Academy's institutes, those of Metal Ceramics and Special Alloys, Metal Physics, and Physical Engineering, have important assignments in this connection. First of all they must establish the theory of basic processes in powder metallurgy, and must create new contact, magnetic, ferrite and other materials with special electrical properties, new materials for cathodes of electron tubes, semiconductors, heat resistant and extra hard alloys, friction and anti-friction materials, etc.

Special attention must be given to powder metallurgy and to the introduction of metal ceramics. Technical economic computations show that in the enterprises of five sovnarkhozes alone, by manufacturing 12,000 tons of articles from iron powder a year, 205 million rubles plus 30,000 tons of nonferrous and ferrous metals can be saved, and also about 1,800 machine tools and about 4,000 workers can be released.

Our scientists who are working on problems in foundry production have much to do. Manufacturing machine parts by casting (instead of by forging followed by mechanical processing) makes it possible to reduce metal input 2-3 times, to reduce the amount of mechanical processing, and to reduce the cost of the articles.

The scientists are seeking ways to improve such progressive technological processes as casting under pressure, casting according to poured models, casting in envelope molds, etc. It must become possible to replace parts from forged and cast steel with parts from cast iron with spheroidal graphite more extensively, and to use new mold materials, in particular, bentonite clay; new technological processes for molding, pouring, cleaning and casting and new methods for the automation and mechanization of casting production must be worked out.

The present policy of introducing automation in production processes everywhere requires intensive investigations on the part of the scientists for the creation of new schemes and principles for automatic operation.

Supported by achievements in physics, electronics and other scientific fields, the scientists must propose new automatic and remote control installations for mining, metallurgy, machine building, power, and other industries. The Institute of Machinery and Automation of the Ukrainian Academy of Sciences has had notable successes in this field; it succeeded in working out a number of installations which are now successfully operating in various Ukrainian enterprises. For example, the Institute designed instruments which are effectively being used to prospect for and exploit ore, gas and petroleum deposits. In agreement with the adopted plan, research is developing in problems of automating technological processes in

chemical and heat and power enterprises, and in improving remote control systems for operating dispersed projects in the petroleum and gas industry; work is being done in the field of transporting coal by hydraulic methods, theoretical and experimental research is being conducted on the possibilities of applying acoustic methods in geophysical prospecting within a mine, etc.

The Ukrainian Academy of Sciences must assist in every way in increasing the productivity of blast-furnaces and open-hearth furnaces by using natural gas and oxygen, and in the quickest possible solutions of problems in the multiple exploitation of the extremely rich ore deposits at Kerch'.

Major tasks are now facing our Academy in the chemical sciences.

The Ukraine possesses vast reserves of raw materials for the development of chemical industry -- natural gas, petroleum, coal and lignite, and by-products from agricultural processing.

The production of natural gas in the Ukraine will be increased to 31.5 billion cubic meters annually in 1965. Natural gas, in addition to its basic component, methane, contains a large number of other valuable substances: ethane, ~~propane~~, butane and other hydrocarbons. Part of these products are subject to condensation in liquid form as soon as they leave the wells. The Shebelinka field alone is now producing annually as much as 300,000 tons of propane, butane and other hydrocarbon condensates.

Raw materials valuable for the chemical industry are also contained in large quantities in the Donbass gas coals. At the present time, as much as 100,000 tons of gas coal are being mined daily, of which as much as 65% is being burned in furnaces without utilization of the chemical products they contain. If these products are used, a plant processing, for example, 3.5 million tons of gas coal annually, will be able to produce, in addition to the coke for fuel, as much as 43,000 tons of benzene, 10,000 tons of toluene, 3,500 tons of xylene, 5,000 tons of carbolic acid, 150,000 tons of resin, 700 million cubic meters of hydrogen, 310 million cubic meters of methane, ethane, and other valuable products.

The great savings which the proper use of natural fuels promises place a demand on our scientists in the Heat and Power Institute and Gas-Use Institute, as well as those in other research establishments in the Republic, to work out more quickly and efficiently complex methods for the chemical processing of petroleum, coal and natural gas. This will make it possible to obtain raw materials for the preparation of such valuable substances as plastics, artificial fibers, glues, dyes, detergents, fertilizer materials, and many others.

As one of the major achievements in this field, we may note the successful designing by the Heat and Power Institute of the first experimental production apparatus in the country for the use of lignite in power engineering. This apparatus distills from the lignite a semicoke resin, a valuable product containing phenol, paraffin, liquid fuel and other substances and differs from existing processes abroad in its high productivity and efficiency.

The research work of scientists of the Ukrainian Academy of Sciences on high molecular compounds are directed toward obtaining, from raw material reserves in the Ukraine, the starting materials for manufacturing plastics and synthetic fibers. The Institute of Polymer and Monomer Chemistry established in the Ukrainian Academy of Sciences, working with the Plastics Institute of the Stalinskiy Sovnarkhoz and other research institutions, must overcome the lag in the development of this field of science in the Ukraine.

One of the deciding factors in the successful development of the chemical industry is the selection of active catalysts providing an acceleration of chemical processes and an increase in the yield of chemical products. The scientists of the Academy and other research establishments are faced with the extremely important task of searching out the most efficient catalysts for a number of chemical production processes and putting them to use in industry.

Of special significance for the economy is the synthesis of new substances with valuable properties from petroleum and gas as raw materials. Keeping in mind the prospects for the increase of oil production in the Ukrainian SSR, and likewise the inadequate study so far made of the chemical composition of Ukrainian oils, the research institutions of the Ukraine are conducting concentrated research on the composition of the oils and the products obtained from them. This work is making it possible to improve oil processing considerably, and particularly to find new possibilities for the use of petroleum paraffin as a chemical raw material.

The existence in the Ukraine, especially in Krymskaya Oblast of large deposits of potassium and magnesium salts, gypsum, limestone, phosphorite and other minerals, places major theoretical and practical problems in extracting and processing these valuable minerals before our scientists, particularly the personnel of the Academy's Institute of Mineral Resources.

Attention should be given to the role which Ukrainian scientists, particularly the personnel of the Institute of General and Inorganic Chemistry, must play in the solution of the economically important problem of providing a water supply for Ukrainian cities, industrial enterprises and agriculture.

The shortage of drinking and industrial water now felt in the Republic is aggravated by the pollution of water sources by industrial waste. A major improvement can be achieved only on the basis of an earnest study of reservoir management and the development of advanced engineering in water treatment. The necessity of providing agriculture with water urgently requires expanding research on the underground water of the Ukrainian SSR, particularly of the dry zone, for use in irrigation.

Experience has shown that success in the scientific research of the Academy's institutes is achieved only by close cooperation with industry. Institutes which have been able to achieve this, the only correct approach, are in a position to solve important scientific problems, thereby raising the technical level of all branches of the economy. Outstanding in this respect are such establishments of the Ukrainian Academy of Sciences as the Institute of Electric Welding of Metal Ceramics and Special Alloys, and of Radio Physics and Electronics.

, To solve the scientific problems raised by industry more efficiently, a number of institutes have set up branches in large industrial centers of the Republic -- Stalino, Dnepropetrovsk, Zaporozh'ye and Krivoy Rog. The institutes are establishing laboratories right in the plants; in Kiev plants alone, thirteen such laboratories have been established during the current year.

Many institutes are now carrying on research work in accordance with industrial contracts signed with enterprises in the Republic. Thus, the Institute of Electrical Engineering has signed contracts with 34 enterprises and establishments. The Laboratory of the Automatic Regulation of Production Processes, in accordance with a contract, is engaged on designing a special system of hydraulic excavators in mines which will be controlled by cybernetic apparatus in accordance with a given program without human participation. The Institute of Machinery and Automation has established close relations with the enterprises of the L'vovskiy Sovnarkhoz, and agreement has been reached in regard to joint work on certain topics included in the Institute's Plan. Many other such facts and examples could be cited.

However, many of the Academy's research establishments have not done all that is necessary to bring science and industry together. Among these, in particular, are the Institutes of Organic Chemistry, Physical Chemistry, Metal Physics and Hydrobiology. These institutes are still not giving enough attention to problems having great importance for the economy, and show little concern for the introduction of the results of their research into production. For example, in the Institute of Ferrous Metallurgy, the Section of Automation and Mechanization of Metallurgical Production and the Metals Section have not had any results for introduction into production for many years. The Institute of Organic Chemistry in 1958 failed to fulfill its plan for introduction into production in three topics -- purifying sugar juice in a second saturation using ion-exchange equipment, production of fruit syrups and the organization of production of a Vitamin B₁₂ compound for livestock. From year to year the plan fails to include the introduction into production of work on the synthesis of new anti-tubercular compounds. The results of research on the problem of organic dyes which are suitable for practice are very insignificant.

Several institutes are still carrying on work which is being conducted on the basis of a tradition of many years and which is directed only towards accumulating additional data to support previously discovered principles or to refine the details of phenomena which had already been studied. Such work, while they are of interest in adding to our fund of knowledge, still cannot provide anything basically new, and carrying out such work drains off the efforts of a large number of people and considerable funds. It is necessary to decisively give up such work and to switch our forces over to more important topics presented by life. We must strengthen our ties with enterprises in every way, establish such forms of cooperation as conducting joint research under industrial contracts and contracts of Communist cooperation between science and industry, study the experience of innovators and conduct joint research with plant laboratories.

Of major importance is the study of the work of plant laboratories and the generalization of materials on the control over production processes, quality, etc., which is accumulating in the laboratories. Such an analysis provides opportunities for the improvement of technological processes and production methods.

Especial attention must be given to improving the coordination of the scientific work of the Academy's numerous scientific establishments, the higher educational establishments, the specialized institutes and the plant laboratories of the Republic, as well as to the coordination of research with the establishments of the USSR Academy of Sciences and the academies of sciences of the union republics.

Over 50 councils and commissions have now been established in the Ukrainian Academy of Sciences, coordinating research on major scientific problems: use of atomic energy, radio physics, radio engineering and electronics, the scientific basis for production automation, astronomy and astrophysics, etc.; our Academy's institutes of Biochemistry and of Electric Welding have been made responsible for coordinating research on an all-union scale. The councils determine the topics and maintain communication with the specialized scientific research establishments, enterprises, sovnarkhozes, ministries and departments. It must be noted, however, that a number of coordinating commissions are operating unsatisfactorily.

Correcting these shortcomings will make it possible to raise scientific work to a new, higher level.

The Seven-Year Plan for the work of the Ukrainian Academy of Sciences provides for a further growth in the network of scientific establishments, the establishment of new institutes and laboratories, and an increase in the number of scientific personnel. In the system of the Ukrainian Academy of Sciences alone it is intended to establish 18 new institutes: institutes of Semiconductors, Radio Engineering Problems, Colloid Chemistry, Biophysics, Ore Deposits, Physics and Mathematics, Geophysics, Turbines, Rare Metals, etc. In addition, over 180 additional new laboratories and sections will be established in the already existing institutes.

The concern shown by the party and the government about the development of science is obligating us to new fruitful efforts. It must be remembered that the efforts and funds which are at our disposal must be used with maximum effectiveness.

The efforts of the Academy's powerful collective of scientists, capable of solving major scientific tasks, must be directed toward giving every possible assistance to the national economy. Under present conditions, the question of introducing already completed work into industry is of special importance. It is necessary to establish special experimental plants which could quickly manufacture the first models of instruments and machines, test new technological processes on a semi-industrial scale, etc.

The new responsible tasks ahead of the Ukrainian Academy of Sciences require a further improvement in scientific organizational work. In this connection, it is necessary that the work of the division offices of the Ukrainian Academy of Sciences meets higher standards; these offices still do not play a sufficient role in the life of the scientific establishments and do not always help the institutes in solving practical problems.

Special attention must be given to high-quality selection and training of scientific personnel. The present system of periodic competitions and certification of scientific personnel, a reliable method for recruiting talented, experienced specialists for the institutes, is not sufficiently used by the heads of the scientific establishments.

Thus, special attention to the basic scientific problems, an improvement in the connection between science and the practice of Communist construction, and the overcoming of the existing shortcomings in the work of the Academy's establishments are all necessary for a successful struggle for technical progress by Ukrainian scientists.

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